PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
H01R 31/00, G06F 12/06, H01R 23/68

A1

(11) International Publication Number: **WO 97/43805**

(43) International Publication Date: 20 November 1997 (20.11.97)

(21) International Application Number: PCT/US97/08108

(22) International Filing Date: 12 May 1997 (12.05.97)

(30) Priority Data:
8/140647 10 May 1996 (10.05.96) JP

(71) Applicant *(for all designated States except US)*: THE WHITAKER CORPORATION [US/US]; Suite 450, 4550 New Linden Hill Road, Wilmington, DE 19808 (US).

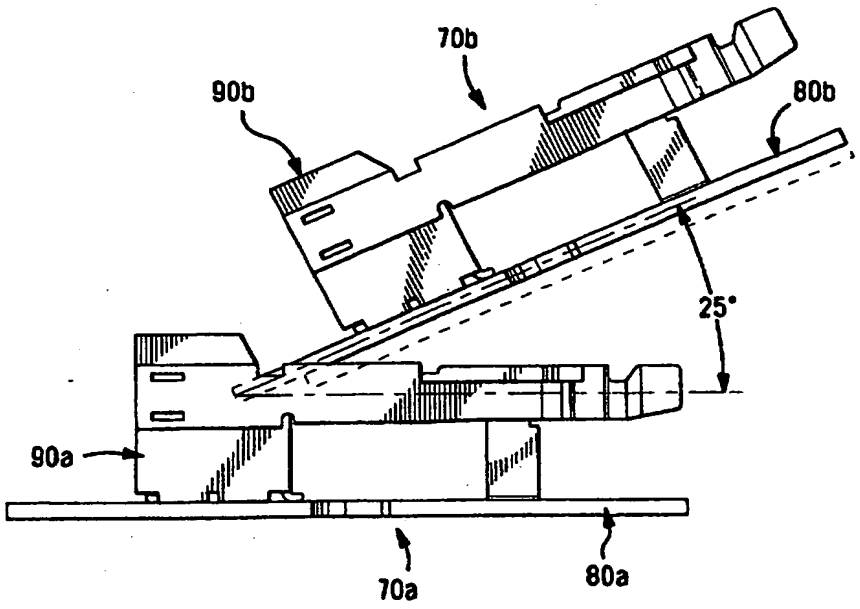
(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: YAMADA, Soji [JP/JP]; B-101, 2-4-14, Narusedai, Machida-shi, Tokyo 194 (JP).

(74) Agents: KAPALKA, Robert, J. et al.; The Whitaker Corporation, Suite 450, 4550 New Linden Hill Road, Wilmington, DE 19808 (US).

(81) Designated States: BR, CA, CN, CZ, FI, HU, KR, MX, NO, PL, RU, SG, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: MEMORY MODULE AND CONNECTOR FOR THE SAME



(57) Abstract

A long, slender housing (20) is provided which has rows of contacts (30 and 40) fastened by press-fitting on the opposite front and back surfaces of this housing. Furthermore, a connector (10 or 90) is formed by means of latches (50a and 50b) which are fastened to both end portions of the housing. A memory board (60 or 80) has contacts or pads (82) on both sides of one edge, and may constitute a DIMM together with a plurality of IC memories (84). Memory modules (70a-70c) which can be connected in a multi-stage configuration are constructed by installing such a connector (90) as an integral part of such a board (80).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

MEMORY MODULE AND CONNECTOR FOR THE SAME

The present invention concerns a memory module, especially an expandable or augmentable memory module which is used in a personal computer (PC) or the like, and a connector which is used with this memory module.

As a result of progress made in semiconductor integrated circuit (IC) technology, and especially in microprocessor (MPC) technology, there has been a continuing increase in the speed and performance of PC's and the like using such circuits. Similarly, memory modules using semiconductor memories (RAM: random access memories, and ROM: read-only memories) which utilize such technology have also shown a continuing increase in memory capacity.

In PC's and the like, there is conspicuous competition to increase performance and reduce cost. Accordingly, in the case of the semiconductor memory capacity of PC's and the like, the cost of standard products has been lowered by manufacturing standard products that have the minimum required memory capacity. However, depending on the user or the application involved, cases often arise in which the internal semiconductor memory capacity of a standard PC is inadequate. In order to provide a countermeasure for use in such cases, expandable (or augmentable) memory modules with memory capacities of 8 MB (megabytes), 16 MB, 24 MB or the like have been offered as options by PC makers.

In order to allow the connection of such expandable memory modules to motherboards in PC's, SIMM (single in-line memory module) or DIMM (dual in-line memory module) connectors are commonly installed inside PC's. If necessary, users may purchase such optional memory modules (SIMM or DIMM) and connect these modules to the connectors described above, thus adding an expandable memory to the memory already present in the PC.

Examples of SIMM connectors are disclosed in U.S. Patent No. 4,850,892, U.S. Patent No. 5,002,494 and Japanese Utility Model Kokai No. 6-31088. In the connector disclosed in U.S. Patent No. 4,850,892, a maximum of two SIMM's are connected to the main circuit board in a perpendicular relationship. In the connectors disclosed in U.S. Patent No. 5,002,494 and Japanese Utility Model Kokai No. 6-31088, SIMM's are connected to the main circuit board in a parallel relationship. Furthermore, an elastic latching device for the connector disclosed in Japanese Utility Model Kokai No. 6-31088 is disclosed in U.S. Patent No. 5,484,302.

When even further memory capacity is added, SIMM's become inadequate; in such cases, contacts are formed on both end surfaces (edges) of the board. Examples of such DIMM connectors are disclosed in U.S. Patent No. 5,263,870, U.S. Patent No. 5,443,394 and U.S. Patent No. 5,425,651.

In the case of conventional memory modules such as SIMM's, DIMM's or the like, a separately purchased memory module, e. g., an 8 MB expandable memory, is inserted and connected in the slot of a SIMM or DIMM connector. However, in cases where (for example) it is necessary to expand or augment the memory capacity by 24 MB, the existing 8 MB memory module must be removed and replaced by a new 24 MB memory module. As result, the existing 8 MB memory module is no longer utilized. Although the cost of memory modules continues to drop, such memory modules are still rather expensive; accordingly, such module replacement leads to a waste of resources. Furthermore, conventional expandable memories occupy a considerable amount of board space.

Accordingly, a problem to be solved by the present invention is how to increase memory capacity without discarding expensive memory modules that are currently in use, and without requiring a large amount of board space.

This problem is solved by a memory module of the present invention which uses a two-stage or multi-stage structure in which a connector for attachment of conventionally used memory modules is formed as an integral part of a new memory module. More particularly, the memory module of the present invention is equipped with a circuit board which has a plurality of contacts formed along its edge, and a connector which is attached to and connected with this circuit board. An existing memory module is installed in this connector, and the memory module of the present invention is connected in the slot of the existing connector on the board. As a result, both the new memory module and the existing memory module are connected in parallel, so that a memory module with a large memory capacity equal to the sum of the memory capacities of both memory modules can be realized as a two-stage construction.

In a preferred working configuration of the present invention, an existing 8 MB memory module can be replaced by a new 16 MB memory module, or a memory module with a total memory capacity of 24 MB can be obtained by installing the existing 8 MB memory module in the connector slot of the new 16 MB memory module. In this way, the existing 8 MB memory module can still be utilized.

Furthermore, the memory module connector of the present invention has first contacts with elastic contact parts that extend from one of the two opposite surfaces of a long, slender housing to the other, and second contacts with elastic contact parts that extend from this other surface to the first surface. The edge of a memory module board which has contacts (or pads) formed on both surfaces is inserted and connected between the elastic contact parts of the first and second contacts, which are separated from each other by a specified gap.

In the case of such a memory module connector, the elastic contact parts of the first and second contacts can contact the contacts on both surfaces of the edge of the memory module board; accordingly, a DIMM with a large memory capacity can be used. Furthermore, sufficient space is provided for the mounting of a semiconductor memory between the board surface and the surface of the memory module which is inserted into the connector and connected.

The invention will now be described by way of example with reference to the accompanying drawings wherein:

Figures 1(A), 1(B) and 1(C) are front, plan and side views, respectively, of a memory module connector according to the invention;

Figure 1(D) is an enlarged view of a portion of the connector within detail D in Figure 1(B);

Figures 2(A) and 2(B) are a cross-sectional views taken along lines A-A and B-B in Figure 1(D);

Figures 3(A), 3(B) and 3(C) are front, plan and side views, respectively, of a memory module according to the invention;

Figure 4(A) shows a memory module (in phantom lines) being installed in a memory module according to the invention;

Figure 4(B) shows a second memory module according to the invention being installed in a first memory module according to the invention; and

Figure 4 (C) shows a memory module (in phantom lines) being installed in a second memory module according to the invention which in turn is installed in a first memory module according to the invention.

As shown in Figures 1(A-D) and 2(A-B), a connector 10 of the present invention is constructed from a long, slender housing 20, and respective pluralities of first

contacts 30 and second contacts 40 are inserted and fastened in two opposite surfaces 21 and 22 of this housing 20. These contacts 30 and 40 are mutually offset (staggered). A pair of fittings 50a and 50b, which are used for both connector fastening and memory board latching are attached to both ends of the housing 20, and are preferably made of elastic metal plates.

In one embodiment the housing 20 has a length of approximately 63 mm and a height of approximately 10 mm. The first and second contacts 30 and 40 are arranged at a high density on the two opposite surfaces 21 and 22 of the housing 20, at a pitch of approximately 0.8 mm in the direction of length. These contacts are formed (for example) by punching out elastic metal plates which have a thickness of 0.2 mm. The first and second contacts 30 and 40 together total (for example) 144 contacts. Of course, an arbitrary number of contacts may be selected depending on the use involved.

As is shown in Figures 1(A), 1(B) and 1(D), the first and second contacts 30 and 40 are arranged at a constant pitch (e. g., 0.8 mm) along the entire length of the housing 20. However, as will be described later, the memory board has a cut-out which is formed in a position that is offset to one side from the center of the front edge (insertion edge) in order to prevent erroneous insertion and connection of the memory board in the connector 10 in an inverted position. A projection 24 used to prevent erroneous insertion, which engages with this cut-out, is formed slightly offset from the center of the housing 20. Accordingly, the pitch of the contacts 30 and 40 is shifted only in the vicinity of this projection 24. More specifically, some of the contacts are omitted from the housing.

As shown most clearly in Figures 2(A) and 2(B), the first and second contacts 30 and 40 are surface mount type (SMT) contacts which are fastened to the respective

opposite surfaces 21 and 22 of the housing 20 by press-fitting. Each of the first contacts 30 has a substantially linear base part 31 which rises upward from a bottom portion 25 of the housing along the surface 21 on the side of the housing from which the memory board or memory module 60 (indicated by a broken line in Figure 1(B)) is inserted, a soldering tail 32 which extends outward from a bottom end of the base part 31, and a press-fitting fastening part 33 which is formed in the vicinity of the other end of the base part 31. Furthermore, each of the first contacts 30 has an elastic contact part (contact beam) 34 which extends toward the other surface 22 from the previously mentioned other end (or upper end) of the base part 31. This elastic contact part 34 extends from one surface 21 toward the other surface 22 in the vicinity of the bottom surface of a slot 23 formed in the housing 20 in the direction of length. A contact portion 35 which is bowed slightly upward is formed in the vicinity of the tip end (free end) of this elastic contact part.

As shown most clearly by Figure 2(B), the second contacts 40 have a shape resembling that of the first contacts 30. Specifically, each second contact 40 has a perpendicular base part 41 disposed on the other surface 22 of the housing 20, a soldering tail 42 which extends outward from the lower end of this base part, a press-fitting fastening part 43 which extends inward from the vicinity of the upper end of the base part 41, and a relatively long elastic contact part 44 which extends from the upper end along the upper wall of the slot 23 of the housing 20 toward the first surface 21. A contact portion 45 which bows downward is formed on the tip end of the elastic contact part 44.

Furthermore, as shown in Figures 2(A) and 2(B), the respective second contacts 40 and first contacts 30 which cannot be seen at the respective positions of the cross sections are indicated by broken lines. The contact

portions 35 and 45 of the first and second contacts 30 and 40 are formed so that these contact portions are slightly separated from each other in the vertical and front-to-back directions. An edge of a memory board 60 is inserted (at an acute angle relative to the board attachment bottom surface 25) between the contact portions 35 and 45 of the elastic contact parts 34 and 44 of both sets of contacts 30 and 40, and this memory board 60 is pivoted. As a result, electrical contact is established between contact pads (not shown in the Figures) formed on both sides of the edge of the memory board 60, and the contact portions 35 and 45 of the first and second contacts 30 and 40.

In order to connect the memory module 60 to the connector 10, the leading edge of the memory board 60 on which contacts are formed is caused to enter the slot 23 in the housing 20 of the connector 10 as in the case of a conventional SIMM or DIMM socket. Specifically, as indicated by broken lines in Figures 2(A) and 2(B), the leading edge is inserted in the gap between the contact portions 35 and 45 of the elastic contact parts 34 and 44 of the contacts 30 and 40 at an acute angle with respect to the horizontal plane, and is then pushed into the slot 23. In this case, the system is designed so that the memory board 60 cannot be inserted further into the connector 10 unless the cut-out in the leading edge of the memory board 60 and the projection 24 on the housing 20 are correctly aligned, i. e., unless the memory board 60 is oriented correctly and not inverted. Thus, a mechanism which prevents erroneous insertion is provided. The memory board 60 which has been correctly aligned with the slot 23 is pivoted from the acute-angle state described above into a horizontal state (as is indicated by broken lines in Figures 2(A) and 2(B). As a result of this pivoting, the contacts (not shown in the Figures) formed on both sides of the leading edge of the memory board 60 (e. g., at a pitch of 0.8 mm) make elastic contact with

the contact portions 35 and 45 of the first and second contacts 30 and 40 of the connector 10.

Furthermore, alignment projections 26 which are used for alignment with alignment holes (not shown in the Figures) formed in the main board (e. g., PC mother board) to which the connector 10 is attached are formed in the vicinity of both ends of the bottom surface 25 of the housing 20 of the connector 10. The connector 10 and the main board are accurately aligned by means of these alignment projections 26. Two rows of pads are formed on this main board at a pitch of (for example) 0.8 mm. When the connector 10 is attached to the main board, the soldering tails 32 and 42 of the first and second contacts 30 and 40 of the connector 10 are correctly aligned with the pads on the main board. Then, surface mounting connections are accomplished by reflow using a conventional soldering cream or soldering paste, and a universally known method involving irradiation with thermal radiation such as infrared radiation, a laser beam or the like.

Mutual connection of the connector 10 and memory board 60 may be accomplished either before or after the attachment of the connector 10 to the main board. When the memory board 60 is connected by being inserted and pivoted in the slot 23 of the housing 20 of the connector 10 as described above, the latches 50a and 50b made of (for example) elastic metal plates undergo latching engagement with latch parts such as recesses or the like which are formed in both side edges of the memory board 60, so that mutual disconnection (creation of a state of non-contact) due to pivoting of the memory board 60 from the connector 10 or movement of the memory board 60 in the direction of insertion or in the opposite direction is prevented. Furthermore, the latches 50a and 50b may have a conventional structure of the type disclosed in (for example) U.S. Patent No. 5,484,302.

It may become necessary to remove the memory board 60 from the connector 10 in order to replace the memory board 60 with another memory module, or for some other reason. In such cases, the latching of the memory board 60 can be released by elastically bending the tip ends (free ends) of the latches 50a and 50b outward (in the direction which causes mutual separation) with the fingers or by means of a tool. Afterward, the memory board 60 can be removed by pivoting the rear end of the memory board 60 upward and pulling the memory board 60 out of the slot 23 of the housing 20. In other words, the removal operation of the memory board 60 is the reverse of the insertion and connection operation. In Figure 1(B), the state in which the latches 50a and 50b are bent outward during unlatching is indicated by broken lines.

Furthermore, as is indicated most clearly in the side view shown in Figure 1(C), each of the latches 50a and 50b has an attachment leg 52 which drops downward from the vicinity of the latch engagement part 51 toward the main board or attachment board surface; moreover, an attachment surface 53 which is bent along the main (attachment) board surface is soldered to pads on the main (attachment) board surface. Such a construction makes it possible to increase the strength of the fastening of the connector 120 and the latches 50 themselves to the main (attachment) board. As a result, any danger of accidental separation of the memory board 60 from the connector 10 during use can be securely eliminated. However, when the tip (free) ends or operating parts 54 of the latches 50 are operated, the latches 50 pivot outward about the attachment surfaces 53 and fastening parts 55 fastened to the housing 20; accordingly, unlatching of the memory board 60 is possible.

Next, a preferred working configuration of a memory module 70 of the present invention will be described with reference to Figures 3(A-C) and 4(A-C). The memory module 70 is constructed from a memory board (or circuit board)

80, and a connector 90 which is electrically and mechanically attached to this board. Respective pluralities of contacts 82 are formed on both the upper and lower surfaces of the front edge 81 of the memory board 80, and a cut-out 83 which is used to prevent erroneous connection is formed in a position that is slightly offset from the center. Furthermore, as indicated by broken lines in Figure 3(B), a plurality of IC memories 84 such as RAM or the like are connected to at least one side (and preferably to both sides) of the memory board 60. Moreover, latching recesses 85 are formed in both side edges of the memory board 80, and positioning holes 86 are formed in both sides in the vicinity of the front edge 81.

The connector 90 is substantially similar to the connector 10 described above, and has a long, slender insulating housing, first and second contacts, and a pair of latches. Since this connector 90 may have substantially the same construction as the connector 10, a description of the connector will not be repeated here.

The memory module 70 of the present invention is characterized by the fact that this memory module has an integrated structure consisting of a memory board 80 which has a plurality of IC memories 84, and a connector 90 which is attached to one surface (for example, the upper surface).

Next, methods of use of the memory module 70 of the present invention will be described with reference to Figures 4(A), 4(B) and 4(C). First, Figure 4(A) illustrates a first memory module 70a constructed according to the present invention. This memory module 70a has substantially the same construction as the memory module 70 described above with reference to Figure 3; in this module, a memory board 80a and a connector 90a are formed as an integral unit. Naturally, IC memories (not shown in the Figures) are mounted on and connected to the

memory board 80a. The outline of a separate (second) memory module 70b which is inserted in the connector 90a shown in Figure 4(A) at an acute angle of (for example) approximately 25 degrees is indicated by a broken line in the Figures. This other memory module 70b may be a conventional SIMM or DIMM.

Figure 4(B) is a side view illustrating a state in which the second memory module 70b has been inserted for the purpose of mutual connection with the first memory module 70a. The second memory module 70b may also have substantially the same shape and dimensions as the first memory module 70a; however, in this specific example, the overall length of the memory module 70b is slightly shorter than the overall length of the memory module 70a. This prevents the second memory module 70b from protruding to the outside of the first memory module 70a when the second memory module 70b is connected to the first memory module 70a. However, in cases where there is sufficient space inside the electronic device in question, the first and second memory modules 70a and 70b may naturally have the same shape and dimensions.

Figure 4(C) illustrates a state in which the second memory module 70b is completely connected to the first memory module 70a. Specifically, the second memory module 70b in Figure 4(B) is pivoted approximately 25 degrees about the left edge, and the engaging parts 85a of the memory board 80a of the second memory module 70a are engaged with the latches of the connector 90a. This second memory module 70b has mounted thereon IC memories with the desired memory capacity. However, since this second memory module 70b has an integrally connected connector 90b, a memory module which may be a conventional SIMM or DIMM, or a separate (third) memory module 70c [of the present invention] may be connected to the connector 90b to form a successive multi-stage structure. This third memory module 70c is indicated by a broken line in Figure 4(C).

Furthermore, as will easily be understood by a person with an ordinary skill electronics, the plurality of memory modules 70a through 70c connected in a multi-stage structure as described above are selectively operated. Specifically, a plurality of pins designated as RFU (reserved for future use) are provided among the numerous contact pins of the connectors 90a through 90c. By selectively driving the memory modules 70a through 70c using these pins, it is possible to use a plurality of memory banks in parallel. Such driving signals are generally sent from a CPU or the like.

As is clear from the above description, the memory connector of the present invention has a long, slender housing with a relatively high back which is mounted on a memory board on which IC memories are carried or mounted. Numerous first and second contacts are disposed in rows on the front and back opposite surfaces of this connector, and the elastic contact parts of these respective contacts are positioned separately from each other inside a slot. The connector is constructed so that the edge of the memory board of a memory module on which contacts are formed is inserted at an acute angle between the separated elastic contact parts described above, after which the memory board is pivoted so that the memory module is latched by latches on both ends of the housing of the connector. The first and second contacts can be manufactured relatively easily and inexpensively by punching the contacts out of an elastic metal plate and fastening the contacts in place at a specified pitch by press-fitting from both outside surfaces of the housing. Furthermore, the pair of latches can also be easily fastened to both end portions of the housing. Since alignment projections are formed in the vicinity of both ends of the bottom surface of the housing, and since these alignment projections are engaged with corresponding alignment holes in the memory board, the soldering tails of first and second contacts formed at a high density can

be securely aligned with the corresponding pads on the memory board. Furthermore, the pair of latches can be formed by punching out and bending an elastic metal plate, and can be fastened in place by (for example) press-fitting in grooves formed in the housing. In addition, the latches have leg parts which drop downward from the vicinity of the latch engagement parts, and which are fastened by soldering to the memory board. In this way, the connector can be securely fastened to the board, and the danger of accidental unlatching of the memory module during operation can be effectively eliminated.

Furthermore, in the memory module of the present invention, a connector is integrally connected to one surface of a memory board on which IC memories are mounted. In the case of such a memory module, the contacts formed on one edge of the memory board can be connected (for example) to the main board, i. e., motherboard, of an electronic device such as a PC or the like in place of a previously connected memory module. Then, the memory module which has been removed can be re-connected to the connector of the memory module of the present invention so that both memory modules can be used simultaneously. Alternatively, a plurality of memory modules of the present invention in which memory boards and connectors of similar construction are formed as integral units may be connected to each other in a multi-stage construction. Accordingly, in cases where sufficient space is available above the motherboard, the memory capacity can be expanded without any substantial increase in the area occupied on the motherboard, and without wasting expensive memory modules. In the specified example of the present invention described above, the height of one memory module is approximately 11 mm, so that a low structure with a height of approximately 20 mm can be obtained even if modules are connected to form a two-stage construction. Furthermore, the maximum height in cases where a third memory module is inserted

into such a two-stage memory module can be kept to approximately 30 mm.

CLAIM

1. A memory module comprising a circuit board (80a) having a plurality of contact pads (82) formed along an edge of the board, characterized in that:

a connector (90a) is mounted on the circuit board for electrically connecting with a second memory module (80b), thereby permitting a multi-stage memory module construction.

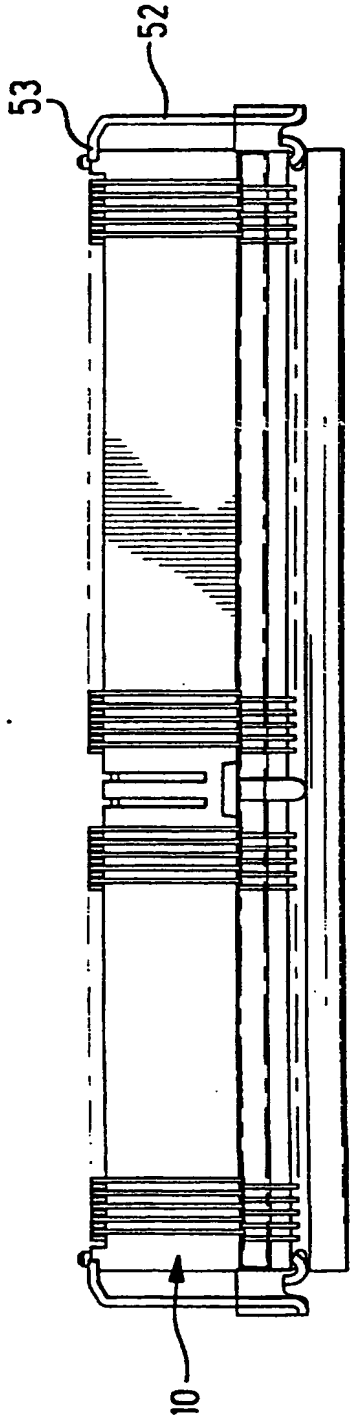


FIG. 1A

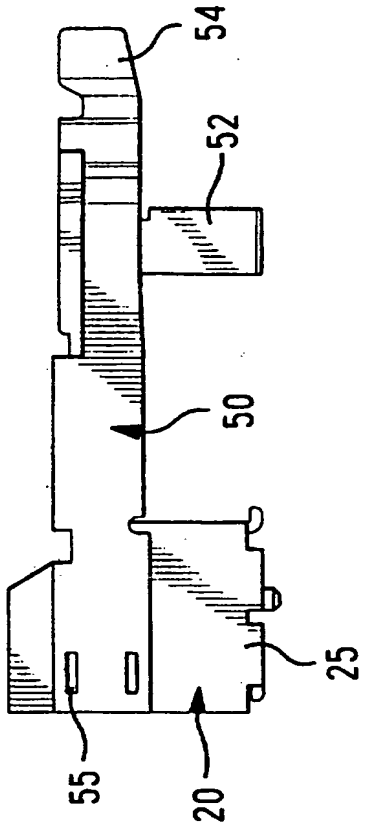


FIG. 1C

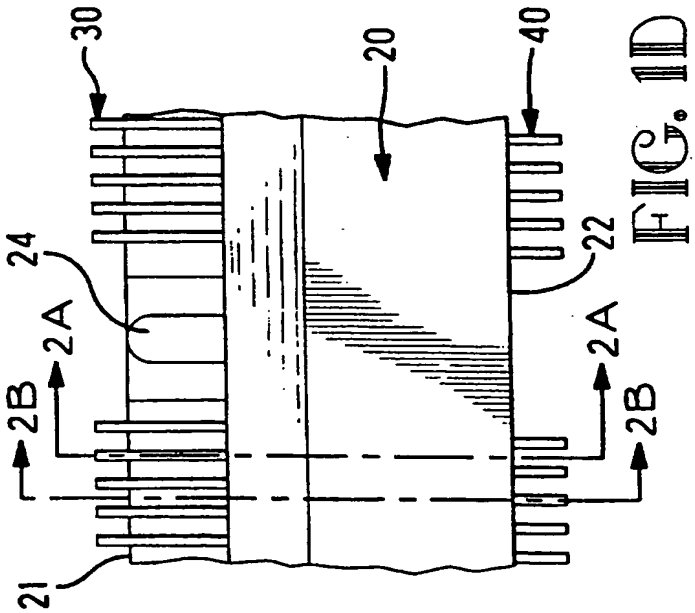


FIG. 1D

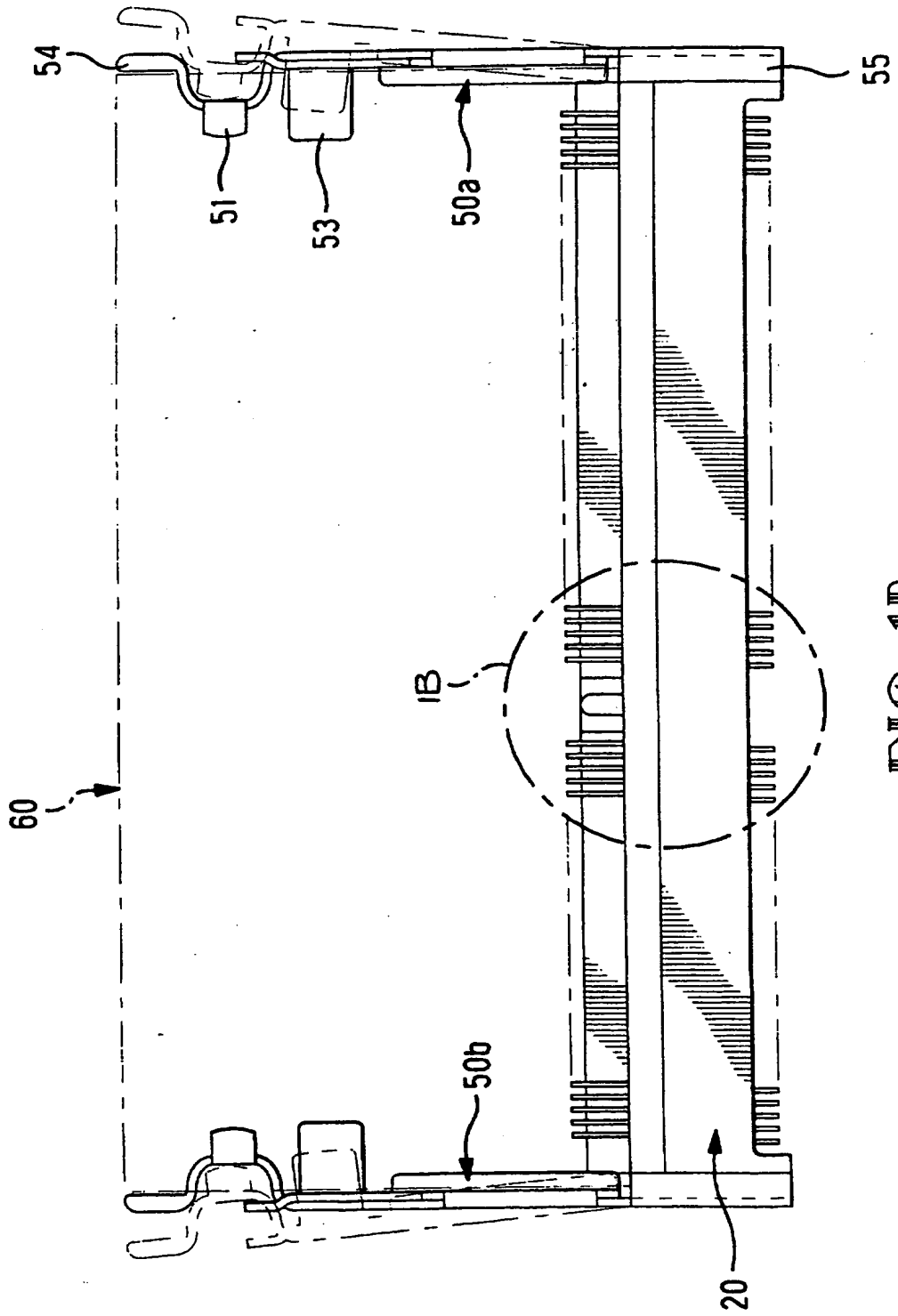


FIG. 1B

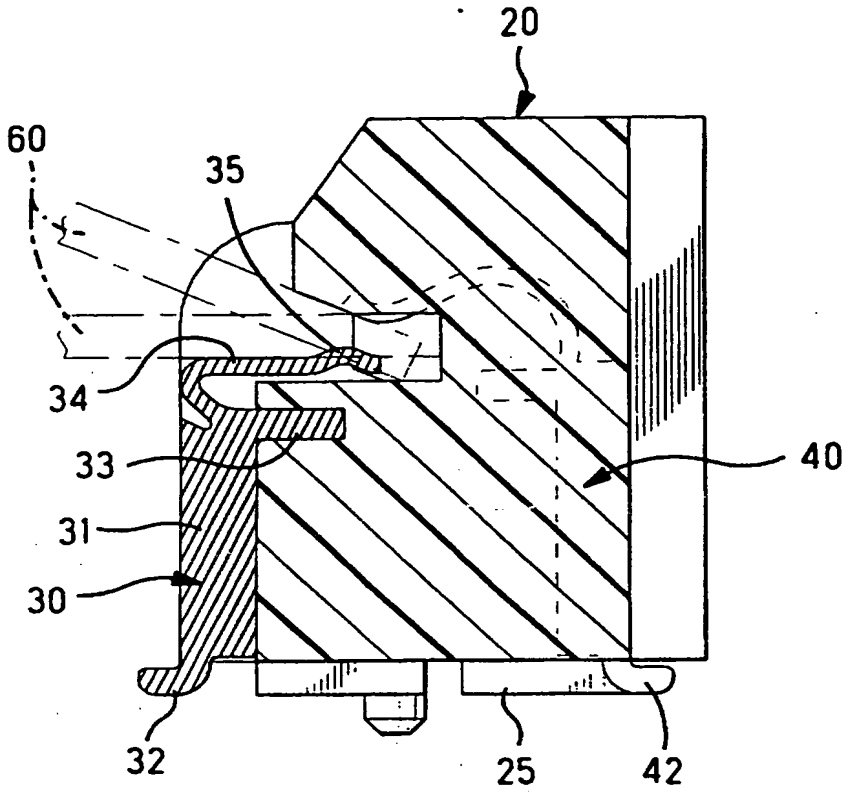

20
60
35
34
33
40
31
30
32
25
42

FIG. 2A

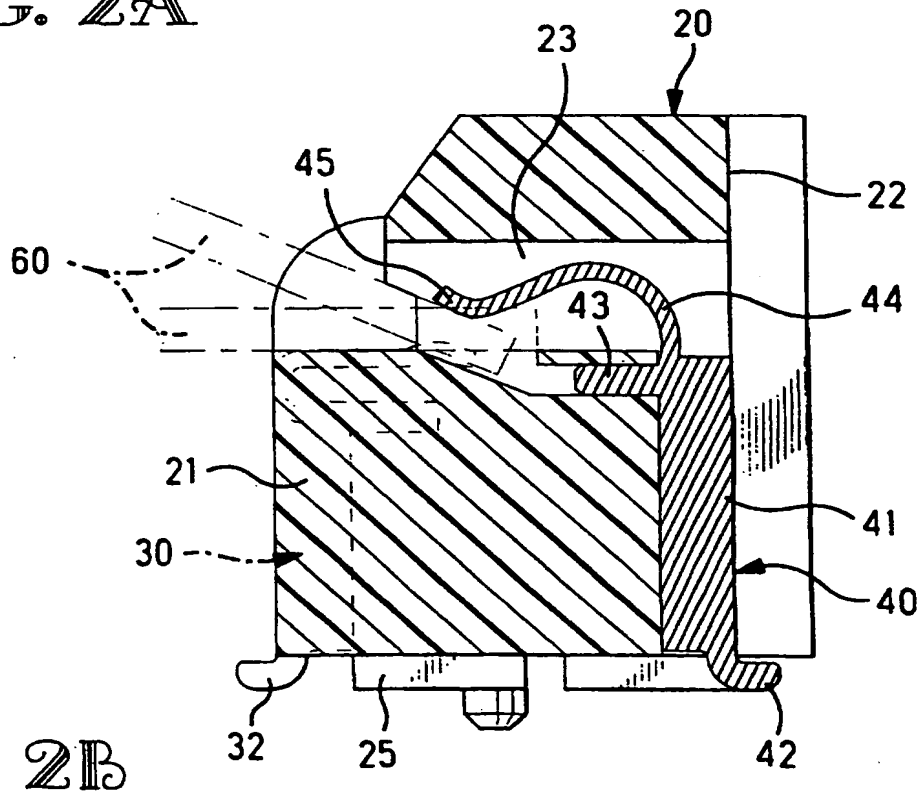

23
20
45
22
60
43
44
21
41
30
40
32
25
42

FIG. 2B

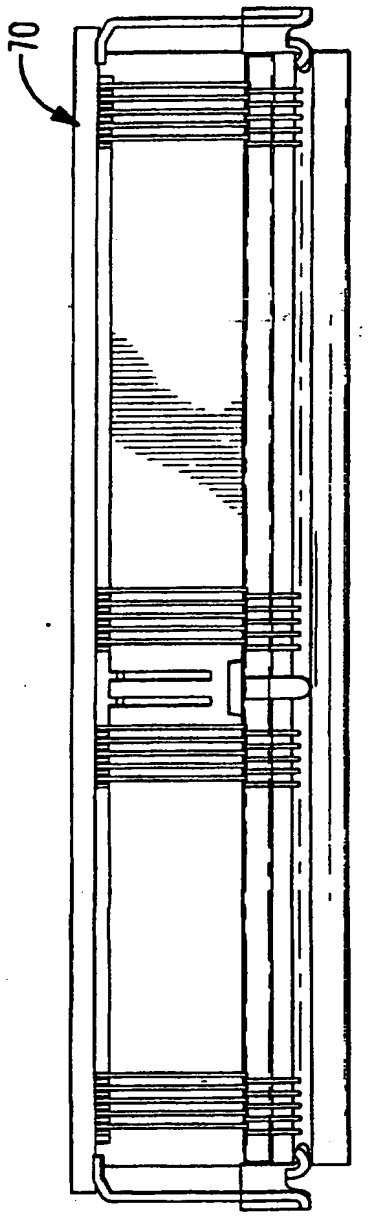


FIG. 8A

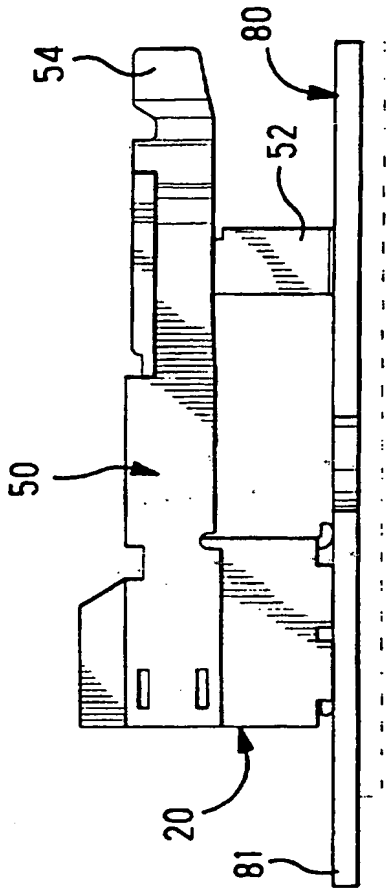


FIG. 8C

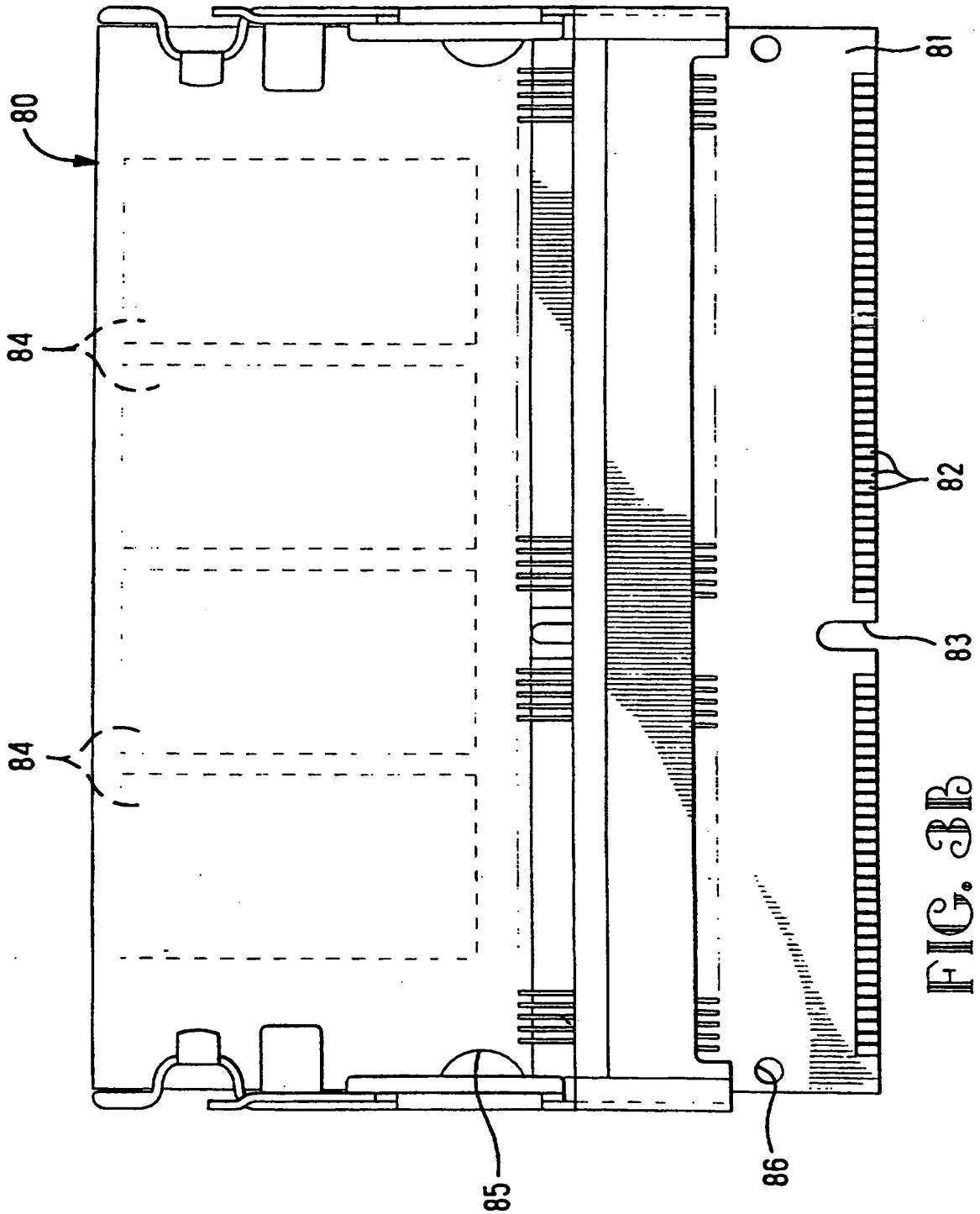


FIG. 3B

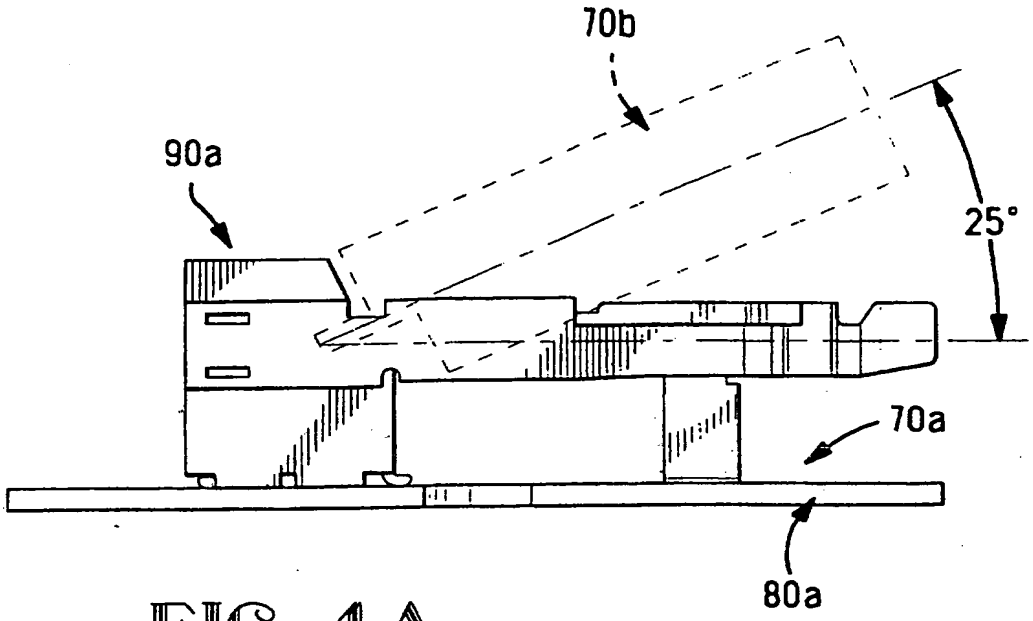


FIG. 4A

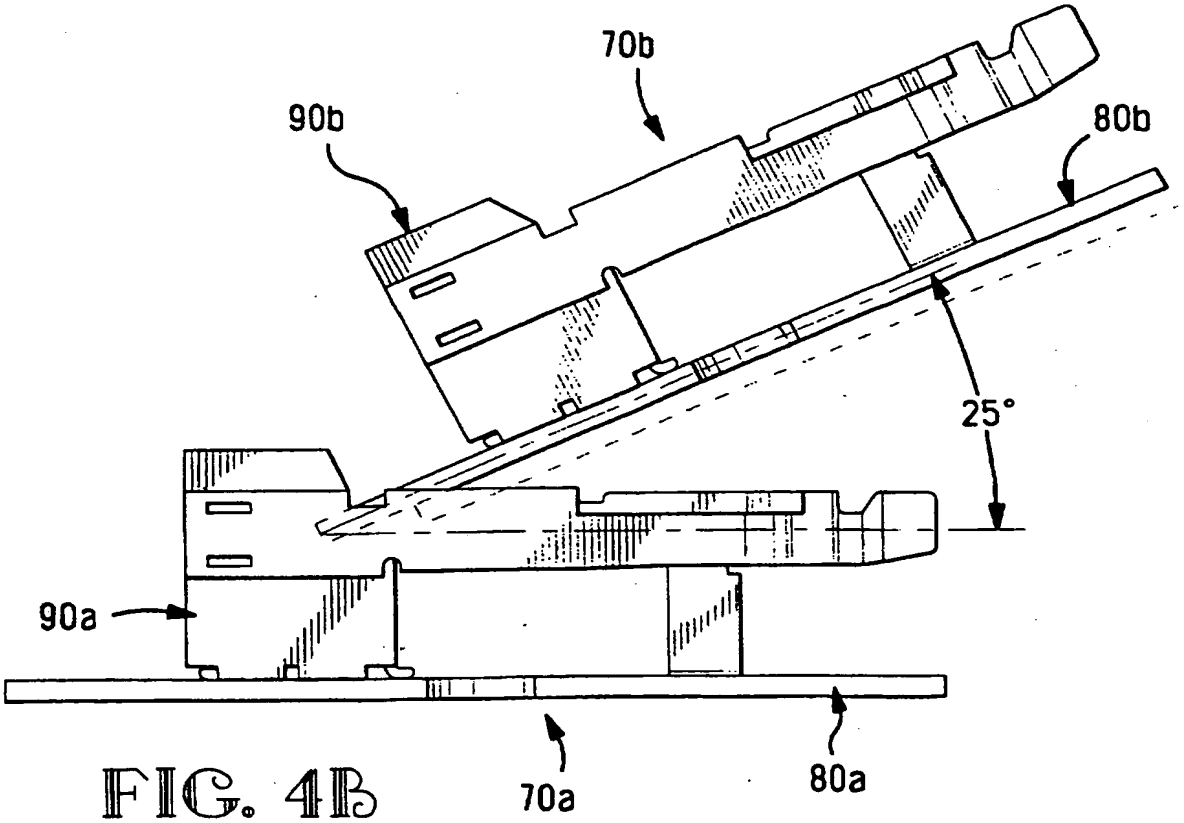


FIG. 4B

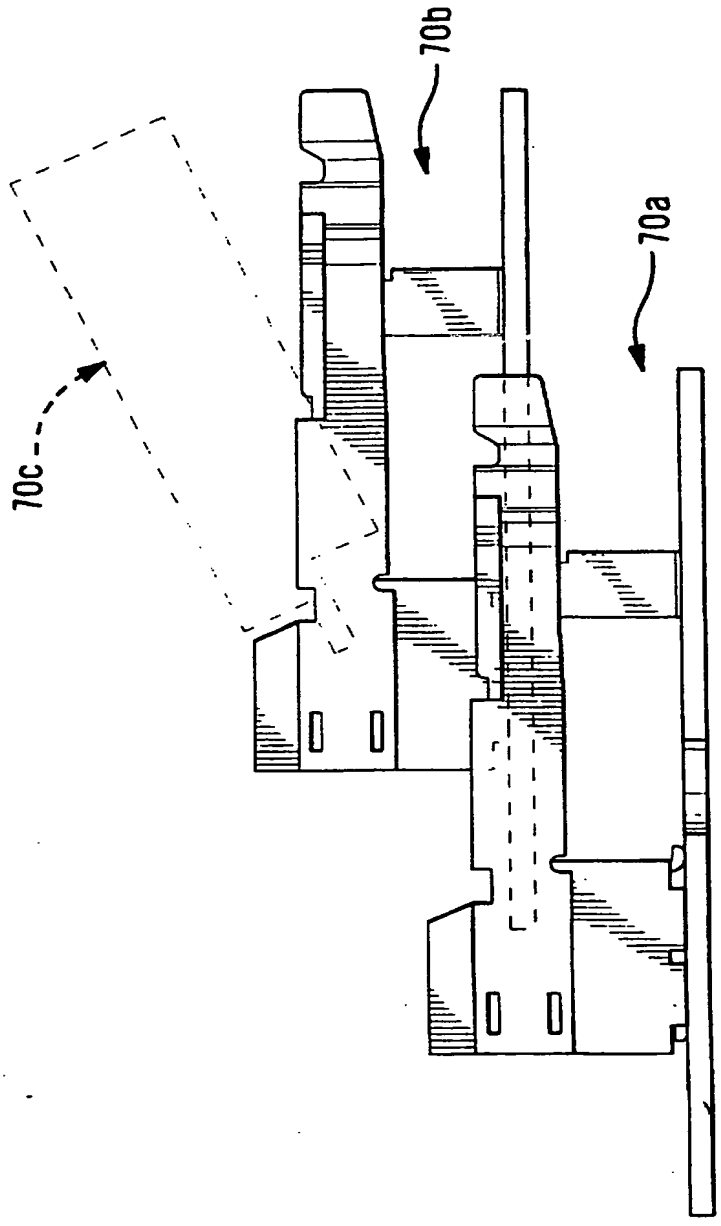


FIG. 4C

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/08108

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01R31/00 G06F12/06 H01R23/68

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01R G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 096, no. 004, 30 April 1996 & JP 07 334415 A (MELCO:KK), 22 December 1995, see abstract ---	1
P,X	PATENT ABSTRACTS OF JAPAN vol. 097, no. 003, 31 March 1997 & JP 08 314800 A (MELCO:KK), 29 November 1996, see abstract ---	1
A	US 5 214 570 A (SHAH BHUPENDRA C ET AL) 25 May 1993 see column 6, line 3 - line 38; figures 5,6 --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 September 1997	17.09.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Tappeiner, R

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/08108

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5214570 A	25-05-93	NONE	
US 5200917 A	06-04-93	NONE	

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/08108

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 200 917 A (SHAFFER JAMES M ET AL) 6 April 1993 see column 3, line 1 - column 4, line 51; figures 2,3	1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)